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# Administration of Emergency Medicine

## EMERGENCY DEPARTMENT PATIENTS WHO STAY MORE THAN 6 HOURS CONTRIBUTE TO CROWDING

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□ **Abstract—Background: Admitted and discharged patients with prolonged emergency department (ED) stays may contribute to crowding by utilizing beds and staff time that would otherwise be used for new patients. Objectives: To describe patients who stay > 6 h in the ED and determine their association with measures of crowding. Methods: This was a retrospective, observational study carried out over 1 year at a single, urban, academic ED. Results: Of the 96,562 patients seen, 16,017 (17%) stayed > 6 h (51% admitted). When there was at least one patient staying > 6 h, 60% of the time there was at least one additional patient in the waiting room who could not be placed in an ED bed because none was open. The walk-out rate was 0.34 patients/hour when there were no patients staying in the ED > 6 h, vs. 0.77 patients/hour walking out when there were patients staying > 6 h in the ED ($p < 0.001$). When the ED contained more than 3 patients staying > 6 h, a trend was noted between increasing numbers of patients staying in the ED > 6 h and the percentage of time the ED was on ambulance diversion ($p = 0.011$). Conclusion: In our ED, having both admitted and discharged patients staying > 6 h is associated with crowding. © 2010 Elsevier Inc.**

□ **Keywords—length of stay; crowding; 6 hours; walk-out; diversion**

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### INTRODUCTION

Emergency Department (ED) crowding is a serious problem in the United States. Prior research has shown that inpatients boarding in the ED and high visit volume contribute to crowding (1). Crowding results in delays in patient care, both on initial presentation and during the visit, and places patients at risk for poor outcomes (1–5). Delays in patient care, especially waiting to be evaluated and treated, is a significant safety issue for ED patients (2–4,6–8). Two of the major signs of crowding include more patients walking out without being seen and an increase in the percentage of time on ambulance diversion (2,8). Expediting patient care and reducing length of stay may decrease congestion in the ED, reduce crowding, and improve patient safety.

However, admitted patients are not the only patients who spend long hours in the ED utilizing bed space and staff time. A prolonged length of stay in the ED by any patient may negatively impact patient flow and contribute to crowding by the utilization of resources (i.e., beds and staff time) that prevent new or existing patients from

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receiving care. In 2004, the average length of stay (LOS) for ED patients in the United States was 3.3 h, but 9.7%, or approximately 10 million patients, spent more than 6 h in the ED (1).

The purpose of our study was to describe the characteristics of all patients staying > 6 h in a single ED during 2004 and to determine the association between patients staying > 6 h and measures of ED crowding.

## MATERIALS AND METHODS

We conducted a retrospective study comparing patients whose ED length of stay was ≤ 6 h to those whose length of stay was > 6 h. The 6-h time threshold was chosen a priori for several reasons: it was an ED quality marker for Blue Cross-Blue Shield; the threshold is included in the National Hospital Ambulatory Medical Care Survey; and it is approximately twice as long as the average ED visit (1). The study protocol was approved by the institutional review board.

The study was performed over a 1-year period between January 1, 2004 and December 31, 2004 in the ED of a 600-bed academic, urban medical center in New England. The facility is the only Level I trauma, pediatric, and tertiary referral center for the western part of the state.

Depending on the time of day, the ED was staffed by two to four board-certified attending emergency physicians, two to four post-graduate year-2 and year-3 emergency medicine residents, zero to two post-graduate year-3 and year-4 medicine, pediatric, and medicine-pediatric residents, one to two physician assistants, 10 to 21 registered nurses, four to six medical assistants and orderlies, and zero to two post-graduate year-1 residents and 4$^{th}$-year medical students. Staffing was highest during peak hours (11:00 a.m.–1:00 a.m.). Scheduled staffing did not change during the study period. The ED is divided into three adjacent areas: the main ED (30 regular beds plus 8 hallway spaces, open 24 h per day), a fast track area (12 additional regular beds, open 16 h per day), and a pediatric ED (6 additional regular beds plus 3 hallway spaces, open 8 h per day). Thus, there are, respectively, 38, 50, or 59 available beds in the ED at any given time. Using hourly median total patient census in the ED, not including the waiting area, the overall scheduled-nurse-to-patient ratio ranged from 1:2.0 to 1:3.5, depending on the time of day. In the area of the ED where the sickest patients are cared for (i.e., the main ED), the overall scheduled-nurse-to-patient ratio ranged from 1:1.7 to 1:2.5, depending on the time of day. The department provides care for an ethnically and socioeconomically diverse population, and covers all medical and surgical specialties.

The ED prospectively tracks time data on all patients: time of arrival, bed placement, admission, and discharge. These time data are complete for more than 99% of ED patients and are defined as follows. Patient arrival is the time the patient first presented to the ED; this time is stamped on the patient's record. Registration time is automatically recorded in the hospital computer at the time the patient is registered. Bed placement is the time the patient was placed in a patient care space within the ED, including a hallway space; this time is recorded by the patient's nurse. Discharge time is the time the patient left the ED either to go home, to an inpatient bed, or to another facility; this time is recorded by the nurse. These values are recorded in real time on the patient's chart and then transcribed into the hospital's database by a trained clerk at the time of ED discharge. Time data are mandatory fields that must be completed at the time of patient discharge (i.e., the computer will not complete the discharge without the times entered). Admission time is the time the admission order was telephoned to the hospital's admissions office by the ED and is entered into the hospital's computer by trained admitting staff. The hospital's electronic databases, including the time data, are then merged to form the ED's DEEDS (Data Elements for Emergency Department Systems)-compliant database that was used for this study (9). Patient demographics and outcome, including when a patient walked out of the ED without being seen by a medical provider, are included in the ED database, as are the specific hours of ambulance diversion from the ED.

The waiting time interval was defined as arrival time to bed placement time. The work-up time interval was defined as ED bed placement time to disposition time. Disposition time was defined as the admission order time for admitted patients and the discharge time for non-admitted patients. The ED length-of-stay time interval was defined as arrival time to discharge time. The hold-time interval was defined as admission order time to discharge time. Laboratory and X-ray study times were defined as any laboratory or any X-ray study ordered, respectively, on a given patient. Data for test ordering were available only for the second half of the study year, as ordering data are kept in a separate data file for only 6 months and then deleted.

Patient characteristics used to compare patients staying > 6 h with those staying ≤ 6 h included: date of service, patient age, gender, ED times, ED physician, tests ordered, disposition status, ED diagnosis, and facility billing level.

The numbers of patients at each step in their ED stay were analyzed at the beginning of each hour during the year to determine the impact of patients staying > 6 h, that is, we quantified how many patients were in the waiting room, how many were in ED clinical beds, how

many empty beds there were, and how many patients with length of stay > 6 h were present at the beginning of each hour for each of the 24 h in every day of the study. Waiting time was not included in analysis of the impact on crowding.

Data were entered using Microsoft Access 97 (Microsoft, Inc., Redmond, WA). Analyses were performed using Stata/SE 8.2 for Windows (Stata Statistical Software, College Station, TX). Medians are expressed with 25% and 75% interquartile ranges (IQR) or 95% confidence intervals. Means are expressed with standard deviations (SD). Statistical inferences were made using analysis of variance, chi-squared, or *t*-tests (or with their non-parametric equivalent where appropriate) with $\alpha = 0.05$.

Length of stay of discharged patients with undifferentiated abdominal pain as determined by treating physician was analyzed separately. To eliminate bias from physicians with limited clinical experience and potential differences between pediatric and adult patients, we examined length of stay for doctors who treated at least 150 adult patients age 18 years or older during the study year with any discharge code for undifferentiated abdominal pain (International Classification of Diseases [ICD]-9 789.00–789.09).

ED diagnoses (ICD-9) were grouped using the Clinical Classification Software from the Agency for Healthcare Research and Quality (10).

## RESULTS

During the study period, 103,613 patients were registered to be seen in the ED and 7051 walked out before being seen by a medical provider. Of the 96,562 who were seen, 16,017 (16.6%) stayed > 6 h. Of the patients who stayed > 6 h, 8169 (51%) were admitted. The median length of stay for admitted patients was 328 min (IQR 234–460) and the median length of stay for discharged patients was 176 min (IQR 120–257). The ED exhibited substantial signs of crowding during the study period, with a walk-out rate of 7.1%, a diversion rate of 2.4% of overall hours, and the holding of a median of 7 and 9 inpatients at 12:00 noon and 6:00 p.m., respectively.

The bar graph in Figure 1 shows the total hours during the year by the number of patients in the ED for a given hour staying more than 6 h (i.e., frequency). The line graph in Figure 1 shows that the percentage of time the ED was on ambulance diversion increased with increasing numbers of patients staying in the ED more than 6 h ($p = 0.017$).

We observed that 83% of the time there was at least one patient in the ED whose LOS was > 6 h. We further observed that 49.7% of the time there was at least one patient in the waiting room prevented from being placed in an ED bed (i.e., there was "blocking" in the queue) because there was at least one patient whose LOS was > 6 h and there were no other open beds. Put another way, 60.1% of the time when there was at least one patient staying > 6 h, there was at least one patient in the waiting room who could not be placed in an ED bed because none was open.

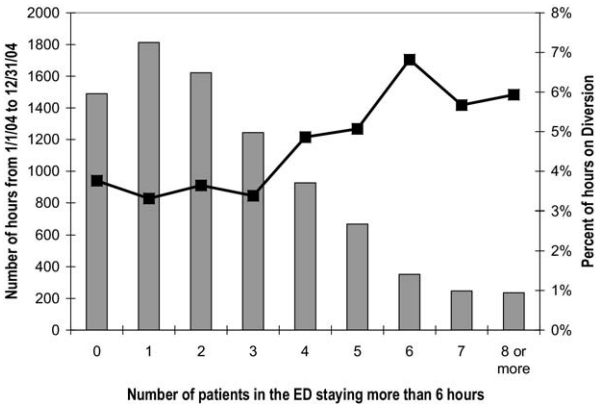


**Figure 1. The frequency of the number of patients in the ED staying more than 6 h and its effect on the percent of time on diversion.**

When there were patients staying in the ED for more than 6 h and the number of patients in the waiting room exceeded the number of available beds, the mean number of "blocked" patients was 3.7 (SD 2.1) (i.e., there were on average 3.7 patients staying longer than 6 h during these conditions). In comparison, when the number of patients in the waiting room was less than or equal to the number of available beds, the mean number of patients in the ED staying > 6 h was 1.7 (SD 1.8), $p < 0.001$.

Furthermore, when there were no patients in the ED staying > 6 h, the walk-out rate was 0.34 patients per hour. In contrast, when there was at least one patient staying > 6 h, the walk-out rate was 0.77 patients per hour ($p < 0.001$).

Table 1 shows demographic, admission, and billing information for patients who stayed ≤ 6 h in the ED with those who stayed > 6 h. Patients who stayed more than 6 h were different than those who stayed less than 6 h for all listed variables ($p < 0.001$).

The waiting, work-up, and hold times are listed in Table 2. Patients who stayed > 6 h spent twice as long in a patient care space within the ED than did patients whose overall length of stay was ≤ 6 h.

The percentage of patients staying > 6 h was significantly associated with the hourly patient volume within the ED. The hourly percentage of patients staying > 6 h was greatest from late morning to early evening (11:00 a.m.–6:00 p.m.: 4.6–6.2% of discharged patients and

**Table 1. Demographics for Patients Staying > 6 Hours and ≤ 6 Hours**

| Variable | Greater Than 6 Hours n = 16,017 | Less Than or Equal to 6 Hours n = 80,545 |
|---|---|---|
| Gender | | |
| Female | 8809 (55%) | 41,077 (51%) |
| Male | 7208 (45%) | 39,468 (49%) |
| Age in years | | |
| < 18 | 962 (6%) | 12,738 (16%) |
| 18–65 | 10,923 (68%) | 56,519 (70%) |
| < 65 | 4132 (26%) | 11,288 (14%) |
| Admission rate | 8169 (51%) | 11,431 (14%) |
| Facility billing levels* | | |
| Level 1 (CPT 36013) | 7 (0%) | 595 (1%) |
| Level 2 (CPT 36021) | 236 (2%) | 20,169 (25%) |
| Level 3 (CPT 36039) | 2351 (16%) | 33,385 (41%) |
| Level 4 (CPT 36047) | 6482 (40%) | 16,782 (21%) |
| Level 5 (CPT 36054) | 6467 (39%) | 7100 (9%) |
| Level 6 (CPT 36062) | 454 (3%) | 1337 (2%) |
| Missing billing levels | 20 (0%) | 1177 (1%) |

Values are counts (percent). For each variable (gender age, admission rate, and billing level), the differences between groups were statistically significant at $\mu = 0.001$.
* Billing level reflects utilization of ED resources and may be used as a surrogate measure of patient acuity with Level 1 (CPT 36013) being lowest and Level 6 (i.e., critical care, CPT 36062) being highest.

4.9–8.0% of admitted patients) and lowest in the early morning (2:00 a.m.–6:00 a.m.: 1.5–2.8% of discharged patients and 1.8–2.4% of admitted patients), coinciding with hourly patient volume ($p < 0.001$).

The most common diagnosis categories (grouped ICD-9 diagnoses) for admitted and discharged patients by length of stay are listed in Tables 3 and 4, respectively (10). The most frequent admitting diagnosis categories were similar for patients who stayed > 6 h and those that stayed ≤ 6 h, although their relative frequencies varied ($p < 0.001$). Abdominal pain and "other psychiatric diagnoses" were the two most common discharge diagnosis categories for those who stayed > 6 h.

Table 5 shows the differences in diagnostic testing for patients who were admitted to the hospital or discharged from the ED, stratified by length of stay. Discharged patients who stayed more than 6 h underwent more diagnostic tests than those who stayed less than 6 h ($p < 0.01$).

The percentage of patients staying for more than 6 h was also associated with the specific attending emergency physician who was supervising the patient's medical care, even after correcting for those few attendings who worked only specific shifts during a 24-h period ($p < 0.001$). For admitted patients in the main ED (i.e., the area with the highest acuity patients), the percentage staying > 6 h for each attending ranged from 38.8% to 49.4% (median 44%, IQR 41.9%–46%). For discharged patients in the main ED, the percentage of total patients who stayed > 6 h who were cared for by a specific attending varied from a low of 15.4% to a high of 23.2% (median 17.9%, IQR 17%–20.5%). In the fast-track section of the ED, this percentage varied from 1.8% to 5.8% (median 2.7%, IQR 2%–3.6%).

Table 6 shows the overall LOS for discharged patients with undifferentiated abdominal pain by treating physician. Overall LOS by treating physician was not different for male patients but varied significantly for female patients ($p < 0.001$).

## DISCUSSION

Crowding is at least partially due to both admitted patients and those ultimately discharged staying in the ED

**Table 2. Time Data for Admitted and Discharged Patients**

| Disposition* | Time† | > 6 Hours n | > 6 Hours Minutes‡ (CI) | ≤ 6 Hours n | ≤ 6 Hours Minutes (CI) |
|---|---|---|---|---|---|
| Admit CC | T1 | 249 | 15 (10–20) | 1408 | 5 (5–6) |
| | T2 | | 229 (213–255) | | 98 (94–103) |
| | T3 | | 195 (171–219) | | 50 (46–52) |
| Admit tele | T1 | 2654 | 15 (15–16) | 2755 | 11 (10–12) |
| | T2 | | 201 (196–207) | | 145 (140–149) |
| | T3 | | 317 (306–331) | | 70 (65–73) |
| Admit floor | T1 | 5210 | 33 (30–35) | 7324 | 15 (14–15) |
| | T2 | | 258 (253–261) | | 130 (128–133) |
| | T3 | | 135 (132–140) | | 81 (80–83) |
| Discharge | T1 | 7904 | 118 (113–123) | 69,058 | 53 (52–54) |
| | T2 | | 335 (330–340) | | 90 (90–90) |

* CC = critical care bed; tele = telemetry bed; floor = regular hospital bed.
† T1 = Waiting time: interval from arrival to ED bed placement; T2 = Work-up time: interval from ED bed placement to disposition (admission order for admitted patients and ED discharge for non-admitted patients); T3 = Hold time: interval from admission order to leaving the ED.
‡ Minutes are expressed as median. CI = 95% confidence interval.

**Table 3. The Most Common Admitting Diagnosis by Patients Staying > 6 Hours and ≤ 6 Hours**

| Admitted Patients Diagnosis Categories* | Overall Prevalence | Greater Than 6 Hours n = 8113 | Less Than or Equal to 6 Hours n = 11,487 |
|---|---|---|---|
| Non-specific chest pain | 7.8% | 776 (9.5%) | 744 (6.5%) |
| Congestive heart failure | 3.5% | 318 (3.9%) | 364 (3.2%) |
| Pneumonia | 3.5% | 252 (3.1%) | 424 (3.7%) |
| Acute myocardial infarction | 3.6% | 240 (2.9%) | 466 (4.1%) |
| Cardiac dysrhythmia | 2.7% | 217 (2.7%) | 309 (2.7%) |
| Coronary atherosclerosis | 2.2% | 182 (2.2%) | 258 (2.3%) |
| Diabetes mellitus | 2.2% | 176 (2.2%) | 247 (2.2%) |
| Acute cerebral vascular disease | 2.2% | 113 (1.4%) | 316 (2.8%) |
| Fluid and electrolyte disorder | 1.9% | 185 (2.3%) | 190 (1.7%) |
| Intracranial injury | 1.8% | 58 (0.7%) | 299 (2.6%) |
| Other | 70.6% | 5596 (69%) | 7870 (66.5%) |

Values are counts (percent). Diagnosis categories are listed in descending order based on overall prevalence. The frequencies of diagnoses between the two groups are statistically significantly different ($p < 0.001$).
* From (10): Healthcare Cost and Utilization Project. Clinical classifications software (CCS) for ICD-10. Available at: http://www.hcup-us.ahrq.gov/toolssoftware/icd_10/ccs_icd_10.jsp.

for a prolonged period of time. The ED usually has limited control of the holding of inpatients, but it has considerably more control of ED patients who are eventually discharged after prolonged visits.

The average length of stay for patients in EDs in the United States is approximately 3.3 h (1). In the United States in 2004, 9.7% of ED patients (approximately 10 million patients) stayed > 6 h in an ED (1). We could not identify any studies in the medical literature describing the subset of patients who stay > 6 h in an ED and their impact on patient flow and crowding, even though this is an established benchmark for quality control that we adopted a priori based upon its prior use by Blue Cross-Blue Shield and the Centers for Disease Control and Prevention.

We found that approximately 17% of patients remained in our ED > 6 h; this is almost double the national average. Half were waiting for an inpatient bed and half were eventually discharged. We found that approximately 50% of the time, at least one patient in the waiting room was prevented from being placed in an ED bed because there was at least one patient whose LOS in the ED was > 6 h and there were no open beds. When this type of blocking occurred, on average 3.7 (SD 2.1) patients in the waiting room were prevented from being brought into the clinical area. Thus, patients staying > 6 h adversely affects patient flow in our ED because it limits our ability to see new patients.

We have found that the percentage of patients who stay > 6 h in our ED is associated with the overall

**Table 4. The Most Common Discharge Diagnosis Categories by Patients Staying > and ≤ 6 Hours**

| Discharged Patients Diagnosis Categories | Overall Prevalence | Greater Than 6 Hours n = 7904 | Less Than or Equal to 6 Hours n = 69,058 |
|---|---|---|---|
| Abdominal pain | 4.5% | 1270 (16.0%) | 2180 (3.2%) |
| Other mental conditions | 1.6% | 402 (5.1%) | 807 (1.2%) |
| Headache, including migraine | 2.8% | 367 (4.6%) | 1790 (2.6%) |
| Superficial injury, contusion | 7.3% | 229 (2.9%) | 5393 (7.9%) |
| Non-specific chest pain | 2.9% | 208 (2.6%) | 2020 (3.0%) |
| Non-infectious gastroenteritis | 1.5% | 195 (2.5%) | 927 (1.4%) |
| Spondylosis, intervertebral disorders, other | 4.0% | 195 (2.5%) | 2869 (4.2%) |
| Alcohol-related mental disorders | 0.5% | 193 (2.4%) | 224 (0.3%) |
| Urinary tract infection | 1.5% | 180 (2.3%) | 985 (1.4%) |
| Superficial sprains and strains | 9.4% | 152 (1.9%) | 7112 (10.4%) |
| Open wounds extremities | 4.0% | 112 (1.4%) | 2946 (4.3%) |
| Other upper respiratory infections | 3.8% | 87 (1.1%) | 2797 (4.1%) |
| Open wounds head, neck, trunk | 3.4% | 146 (1.8%) | 2486 (3.6%) |
| Asthma | 3.2% | 79 (1.0%) | 2365 (3.5%) |
| Other | 49.7% | 4089 (51.7%) | 34,157 (49.5%) |

Values are counts (percent). Diagnosis categories are listed in descending order based on overall prevalence. The frequencies of discharge diagnoses between the two groups are statistically significantly different ($p < 0.001$).

**Table 5. Diagnostic Testing***

| Category Test | Admitted Patients > 6 Hours n = 4067 | Admitted Patients ≤ 6 Hours n = 5967 | Admitted Patients p Value | Discharged Patients > 6 Hours n = 4218 | Discharged Patients ≤ 6 Hours n = 33,055 | Discharged Patients p Value |
|---|---|---|---|---|---|---|
| Laboratory test | 4039 (99%) | 5573 (93%) | <0.001 | 3117 (74%) | 9288 (28%) | <0.001 |
| X-ray study | 3050 (75%) | 4493 (75%) | 0.730 | 1350 (32%) | 9916 (30%) | 0.008 |
| Electrocardiogram | 2884 (71%) | 3652 (61%) | <0.001 | 928 (22%) | 3997 (12%) | <0.001 |

* Results based upon second half of calendar year data (July 1, 2004–December 31, 2004).
Values are counts (percent).

number of patients in the clinical area as well as the attending emergency physician who is taking care of them; for discharged patients, this percentage is also associated with their diagnosis. It makes sense that as the ED gets busier, there are more interruptions in care, and length of stay increases. Variability among physicians is well documented and it is not surprising that the different styles of emergency physician attendings result in different work-up times (11–13). This is an aspect of ED care that the medical community can influence first by researching and then by implementing methods to reduce work-up times. It is also not surprising that some patient complaints, such as abdominal pain, take longer to work up in the ED.

Abdominal pain is the most common chief complaint in EDs across the United States, accounting for 6.8% of all patients, and also was the most prevalent discharge diagnosis for patients staying more than 6 h in our ED (1). This is understandable, as the work-up of patients with abdominal pain can be extensive. We find it noteworthy that in the same ED there were significant differences in LOS with female (but not male) abdominal pain patients among a group of experienced attending physicians. This specific finding supports our assertion that medical practices within the ED do influence the amount of crowding experienced. It is also notable that in this analysis, LOS was quite variable within each physician's practice as well. This is evident by the relatively large standard deviations and differences between mean and median values found in Table 6. Changing how we work-up these patients could result in shorter, more uniform lengths of stay and could improve overall patient flow.

The second most common discharge diagnosis among the > 6-h LOS patients was "other mental conditions." Psychiatric patients require medical clearance, which usually is not extensive unless the patient has new symptoms (14,15). A significant portion of psychiatric patients' length of stay in our ED is waiting for a bed at another institution, as many of these patients were transferred to a psychiatric hospital, a drug rehabilitation facility, or a site providing housing and other support

**Table 6. Length of Stay (LOS) in Minutes by Attending Emergency Physician for Adult Patients with Undifferentiated Abdominal Pain**

| Physician # | Mean (SD) and Median LOS Male Patients | n for Male Patients (Total n = 801) | Mean (SD) and Median LOS Female Patients | n for Female Patients (Total n = 1765) |
|---|---|---|---|---|
| 1 | 366 (241); 352 | 59 | 387 (194); 306 | 112 |
| 2 | 321 (179); 321 | 77 | 385 (257); 275 | 147 |
| 3 | 405 (204); 422 | 53 | 408 (299); 395 | 106 |
| 4 | 374 (205); 349 | 60 | 384 (199); 327 | 154 |
| 5 | 344 (134); 380 | 49 | 433 (227); 332 | 109 |
| 6 | 372 (211); 371 | 45 | 450 (278); 312 | 166 |
| 7 | 374 (272); 466 | 59 | 465 (188); 317 | 106 |
| 8 | 352 (192); 398 | 68 | 429 (259); 308 | 130 |
| 9 | 375 (193); 330 | 45 | 373 (184); 340 | 109 |
| 10 | 373 (204); 370 | 51 | 406 (180); 345 | 119 |
| 11 | 344 (146); 356 | 59 | 395 (218); 352 | 102 |
| 12 | 371 (190); 394 | 53 | 447 (270); 346 | 111 |
| 13 | 315 (184); 331 | 75 | 367 (209); 265 | 170 |
| 14 | 310 (153); 325 | 48 | 335 (169); 267 | 124 |

For the male abdominal patients, there was no significant difference in LOS by physician ($F = 1.12$, $p = 0.341$; Kruskal-Wallis test $p = 0.206$). For the female abdominal pain patients, there was a significant difference in LOS by physician ($F = 3.94$, $p < 0.001$; Kruskal-Wallis test $p < 0.001$).

services; because they were not admitted to our facility, this was not recorded as T3 (i.e., admission to discharge). Of note, transfers from our ED are uncommon except for psychiatric and social service patients requiring placement. Disposition of patients with psychiatric disturbances is becoming increasingly difficult as community services are reduced due to shrinking state and federal reimbursement (16).

Both admitted and discharged ED patients staying longer than 6 h is associated with measures of ED crowding and negatively impacts patient safety. In our study, the prolonged LOS of some patients prevented new patients from being seen and thereby increased waiting time to be seen. We know that delays in care potentially can result in negative patient outcomes (2–4,6–8). We further observed that patients staying longer than 6 h also increased the number of patients who leave without being seen by a medical provider. This finding confirms prior research showing long waiting time to be a significant factor in a patient's decision to leave without being seen (4). Finally, we found that increasing numbers of patients staying longer than 6 h is associated with increasing time on ambulance diversion. Ambulance diversion has been shown to be related to inadequate numbers of inpatient beds (i.e., holding admissions in the ED due to lack of inpatient beds) and high ED volume (1,8). We have now demonstrated that ambulance diversion is associated with patients enduring prolonged ED length of stay, whether they are admitted to the hospital or not. Interestingly, having only a few patients staying more than 6 h did not seem to increase ambulance diversions, but with increasing numbers staying $>$ 6 h, the percentage of time on ambulance diversion did increase. It is not surprising that the ED can accommodate a few patients with prolonged LOS, but it becomes more stressed as that number increases. Ambulance diversion may be more strongly associated with a high number of ED patients and sudden influx of high acuity patients, but the study design did not allow us to examine this possibility (8).

Resolving the problem of patients staying $>$ 6 h in the ED will require additional resources and changes in the admitting practices for both ED and non-ED admissions. Evenly spreading non-ED admissions over the 7-day week (instead of Monday through Friday) has helped in some settings (17–19). Reserving hospital beds for the expected number of daily ED admissions at the beginning of the day might reduce the delays in obtaining hospital beds, but also might reduce the number of available beds for elective admissions. Clearly, the number of staffed hospitals beds needs to be increased to better meet the needs of all patients requiring inpatient services. An Observation Unit to offload non-admitted ED patients with prolonged LOS might minimize the blocking of new patients from being seen because some ED beds are occupied by patients with prolonged ED stays who eventually will be discharged from the ED. Reducing laboratory and imaging turnaround time may reduce length of stay (20). Changing the process of care by increasing the percentage of patients with bedside registration and improving communication and coordination of the ED team with a patient tracking system might reduce length of stay. Our results also suggest that changing the way we work-up abdominal pain and improving disposition options for psychiatric patients might be key factors in expediting the care of these ED patients with prolonged length of stays.

### *Limitations*

Our study's main limitations were that it was retrospective and that it involved only a single ED, although our sample size was adequate for the analyses we performed. It is unknown if our findings can be generalized to other busy EDs that often have patients whose length of stay is longer than 6 h. The a priori choice of a 6-h threshold for our study was based on prior research. However, if we adopted a different time threshold, we may have produced results that imply somewhat different interpretations, although the general trends we found should still remain. Time data, although 99% complete in the database, were not checked for accuracy. Testing data could be obtained only for the final 6 months of the study year; results for the second half of the year may have been different, as this period includes the introduction of new house staff.

## CONCLUSION

This study examines the issue of patients staying longer than 6 h in an Emergency Department. In our ED, 17% of our patients stay longer than 6 h. Half of these patients were patients to be admitted waiting for an inpatient bed, and half were ED patients who were eventually discharged. Patients staying $>$ 6 h contributes to ED crowding by preventing new patients from being seen during the same time period, by increasing the percentage of patients who walk out without being seen by a medical provider, and by increasing the percentage of time the ED is on ambulance diversion. We further observed that there was significant variation in length of stay within the ED among adult, female, abdominal pain patients when stratified by attending physician. Better understanding of how to expedite the care of patients with prolonged ED visits but who are eventually discharged is one way for our specialty to reduce crowding in our EDs.

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## ARTICLE SUMMARY

**1. Why is this topic important?**

Emergency Department (ED) crowding is a major problem in the United States.

**2. What does this study attempt to show?**

Both patients to be admitted and patients to be eventually discharged with prolonged length of stays contribute to ED crowding.

**3. What are the key findings?**

Patients staying longer than 6 h block new patients from entering the ED as there are no available beds. When there are patients staying longer than 6 h, there are increased walkouts and increased hours of ambulance diversion.

**4. How is patient care impacted?**

Patients staying $>$ 6 h contribute to crowding, which has the potential to negatively impact patient safety and quality of care.